On the Transmission of Spillover Risks between the Housing Market, the Mortgage and Equity REITs markets, and the Stock Market

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Using monthly returns for the January 1975 – December 2016 time period in U.S. markets, we report large variations in total, net and pairwise return spillovers across the housing market, the mortgage and equity real estate investment trusts (REITs) markets, and the stock market. Each of the four markets acts as both receiver and transmitter of spillovers during specific subperiods. While in economic downturns the housing market is generally a transmitter of spillovers, we find that during the recent mortgage crisis the housing market was a receiver of spillovers predominantly from the mortgage REITs market but also, to a lesser degree, from the equity REITs market. In periods of high political uncertainty and in periods of easy credit, the equity REITs and the stock market transmit spillovers to the housing and the mortgage REITs market.

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1. Introduction

In the aftermath of the 2007-2008 financial crisis a significant effort has been undertaken in the academic literature to understand the interdependence between mortgage loan performance, housing prices, and stock market returns. The literature relying on household-level data from the financial crisis finds that risks which originated in the subprime segment of the mortgage market exerted a negative impact on housing prices, amplified, and subsequently spread to the stock market and other sectors of the economy (see, e.g., Mayer, Pence, and Sherlund (2009); Gerardi, Rosenblatt, Willen, and Yao (2015); Davis and Nieuwerburgh (2015)). Analyses of data from the pre-crisis period show that the mortgage market followed a classical boom-bust cycle. It substantially expanded in the early 2000s and then collapsed by creating knock-on effects on housing prices, other real estate assets and the stock market (Mayer et al. (2009); Demyanyk and Van Hemert (2011)).

While these analyses contribute to our understanding of the origin and evolution of the financial crisis, they have little to say about the forces shaping the spillover effects across the mortgage, the housing and the stock market for longer time periods. Do return spillovers across these markets change in intensity and direction during periods of economic expansions and recessions? How different are they in periods of housing market booms and in housing downturns? And how do they respond to economic shocks and political events? These questions carry implications for a variety of market players, including homeowners and potential home buyers, investors, policymakers and market regulators.

In this paper we address these issues by analyzing the dynamic interdependence between housing market returns, returns on mortgage and equity real estate investment trusts (REITs), and stock market returns in the U.S. Our study covers the period of the past forty years in which these markets go through episodes of slow and moderate growth and decline as well as through boom and bust cycles. We employ the dynamic spillover methodology developed by Diebold and Yilmaz (2012) to establish the direction and the magnitude of the interdependence across these markets.[1] Our main results can be summarized as follows. For the entire sample period, the housing market is a net receiver of spillovers while the stock and the mortgage and equity REITs markets are net transmitters of spillovers. The dynamic spillovers, however, exhibit substantial variations over time and each market acts both as a transmitter and a receiver of spillovers during different sub-periods. The housing market for example, is a net transmitter during recession periods and during periods of housing market busts. This general relationship, however, does not hold for the subprime mortgage crisis, during which the housing market received spillovers from the mortgage market and, to a lesser extent, from the equity REITs market.

2. Data and methodology

We use monthly time series return data for the U.S. over the period January 1975 – December 2016 to examine the return spillovers across four markets: the housing market (H), the mortgage REITs market (M), the equity REITs market (E), and the stock market (S). Housing returns are measured by the S&P/Case-Shiller U.S. National Home Price Index which we collected from the Federal Reserve Economic Data (FRED). The returns on mortgage and equity real estate investment trusts (REITs) are retrieved from the National Association of Real Estate Investment Trusts (NAREIT). As a proxy for the stock market we use the S&P 500 index which we collect from the Center for Research in Security Prices (CRSP) at the Wharton Research Data Services (WRDS). The descriptive statistics and stationarity tests are presented in Table 1.[2]

[Table 1, about here]

[1] The main advantage of this methodology lies in its ability to quantify the extent to which the forecast error variance of the return of each market is attributable to various shocks to the generalized VAR system that is independent of the ordering of variables. It also allows for a flexible, data-driven model specification which does not require theoretical restrictions on parameters or specific identifying restrictions on shocks (Diebold and Yilmaz (2012), Antonakakis, André, and Gupta (2016)).

[2] The Augmented Dickey-Fuller, the Phillips-Perron and the Zivot-Andrews tests reject the null hypothesis of a unit root at the 10% significance level for all variables. The correlation matrix shows that returns on equity REITs are highly correlated with all three other markets while the correlations between the other three markets are not statistically different from zero.

Following Diebold and Yilmaz (2012), we consider a K-variable VAR model of p-th order given by:

$$y_t = \sum_{i=1}^{p} \Phi_i y_{t-i} + \varepsilon_t \text{, with } \varepsilon_t \sim \text{i.i.d}\,(0, \Sigma) \tag{1}$$

Hereby $y_t = (y_{1t}, y_{2t}, \ldots, y_{Kt})$ represents a vector of K endogenous variables, Φ_i are $K \times K$ parameter matrices where $i = 1,2, \ldots p$ and ε_t is a vector of identically and independently distributed errors with zero mean and Σ variance-covariance matrix. In our particular application, the vector y_t contains the monthly returns of four aforementioned time series. Assuming covariance stationarity, the moving average representation of the VAR(p) model could be written as follows:

$$y_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \tag{2}$$

where the coefficient matrices A_i are of dimension $K \times K$ and recursively defined by $A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + \cdots + \Phi_p A_{i-p}$ where A_0 is the $K \times K$ identify matrix and $A_i = 0$ for all $i < 0$.[3]

The variance decomposition proposed by Diebold and Yilmaz (2012) is based on the KPPS-VAR framework with the h-step-ahead forecast error variance and is defined as follows:

$$\phi_{ij}(h) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (\acute{e}_i A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (\acute{e}_i A_h \Sigma \acute{A}_h e_i)} \tag{3}$$

Hereby σ_{jj} denotes the standard deviation of the error term for the j-th equation, Σ is the variance matrix for the error vector ε, and e_i represents the selection vector with one for i-th elements and zero otherwise. The resulting matrix ϕ_{ij} of dimension $K \times K$ represents the contribution of variable j to the h-step-ahead error variance in forecasting variable i. Hence, the main diagonal elements of this matrix

[3] Using variance decompositions, the forecast error variances of each market could be divided into two parts; own-variance shares and cross-variance shares (hereafter spillovers) based on shocks to the system. Own-variance shares represent the proportion of the h-step-ahead error variance in forecasting y_i due to its own shocks, whereas cross-variance shares show the fraction of h-step-ahead error variance in forecasting y_i that is attributable to shocks in the other markets y_j, where $j \neq i$.

show the own-variance shares while the off diagonal elements indicate cross-variance shares. Each entry of the generalized variance decomposition matrix is normalized by the row sum as follows:

$$\widetilde{\phi}_{ij}(h) = \frac{\phi_{ij}(h)}{\sum_{j=1}^{K} \phi_{ij}(h)} \tag{4}$$

where by construction $\sum_{i=1}^{K} \widetilde{\phi}_{ij}(h) = 1$ and $\sum_{j=1}^{K} \widetilde{\phi}_{ij}(h) = K$.

Using the normalized elements of the generalized variance decomposition matrix, Diebold and Yilmaz (2012) define the total spillover index as follows:

$$TSI(h) = \frac{\sum_{i,j=1, i\neq j}^{K} \widetilde{\phi}_{ij}(h)}{\sum_{i,j=1}^{K} \widetilde{\phi}_{ij}(h)} \times 100 = \frac{\sum_{i,j=1, i\neq j}^{K} \widetilde{\phi}_{ij}(h)}{K} \times 100 \tag{5}$$

The directional spillovers received by market i *from* all other markets are defined as:

$$DS_{i\leftarrow j}(h) = \frac{\sum_{j=1, j\neq i}^{K} \widetilde{\phi}_{ij}(h)}{\sum_{i,j=1}^{K} \widetilde{\phi}_{ij}(h)} \times 100 = \frac{\sum_{j=1, j\neq i}^{K} \widetilde{\phi}_{ij}(h)}{K} \times 100 \tag{6}$$

Likewise, the corresponding index which measures the spillover effects transmitted by market i *to* all other markets is calculated as:

$$DS_{i\rightarrow j}(h) = \frac{\sum_{j=1, j\neq i}^{K} \widetilde{\phi}_{ji}(h)}{\sum_{i,j=1}^{K} \widetilde{\phi}_{ji}(h)} \times 100 = \frac{\sum_{j=1, j\neq i}^{K} \widetilde{\phi}_{ji}(h)}{K} \times 100 \tag{7}$$

Given these directional spillovers indices, net spillovers from variable i to all other variables j could be obtained directly as the difference between total volatility shocks transmitted by market i and those received from all other markets:

$$NS_i(h) = DS_{i\rightarrow j}(h) - DS_{i\leftarrow j}(h) \tag{8}$$

Net pairwise spillovers between each pair of markets i and j are estimated by the difference between total volatility spillover transmitted from market i to market j and those transmitted from j to i:

$$NPS_{i\rightarrow j}(h) = \left(\frac{\widetilde{\phi}_{ji}(h)}{\sum_{i,n=1}^{K} \widetilde{\phi}_{in}(h)} - \frac{\widetilde{\phi}_{ij}(h)}{\sum_{j,n=1}^{K} \widetilde{\phi}_{jn}(h)} \right) \times 100 = \left(\frac{\widetilde{\phi}_{ji}(h) - \widetilde{\phi}_{ij}(h)}{K} \right) \times 100 \tag{9}$$

In the next section we estimate the so defined spillover measures for the considered four markets.

3. Empirical results

The total return spillovers, which we estimate using a 60-month rolling window, are reported in Table 2.

[Table 2, about here]

On average 30.9% of the total volatility forecast error variance in the sample comes from cross-market spillovers which is on par with results from related studies (see, e.g. Antonakakis et al. (2016) Chiang, Sing, and Tsai (2017)). The dynamic estimates of total spillovers (see equation 5) are presented in Figure 1.

[Figure 1, about here]

The figure shows that total spillovers react to political and financial market events.[4] They generally increase in crisis periods, both domestic and international.[5] We further obtain dynamic trajectories for the net spillovers defined by equation (8) and of for the pairwise return spillovers defined by equation (9). The net spillovers for each market are presented in Figure 2.

[Figure 2, about here]

[4] For further studies based on this methodology see e.g. Antonakakis and Floros (2016), Chiang et al. (2017), and Shahzad, Ferrer, Ballester, and Umar (2017).

[5] Starting from the early 1980s, we see an increase in the spillovers with the onset of the Latin American Debt crisis of 1982 which further intensifies with the U.S. savings and loans (S&L) crisis. The following local spillover spike can be associated with the Black Monday (October 19, 1987) in which the U.S. stock market lost almost 22% of its value in a single day. Sharp increases in the spillovers are triggered by the East Asian Crisis (July 1997-January 1998), the Russian crisis (June–August 1998), and the Brazilian crisis (January 1999). The September 11 attack, the dot-com bubble, and the Iraq war (March 2003-May 2003) are events that mark another period of substantial increase in the spillovers. Spikes in the spillovers across the studied market can also be observed following the first signs of the subprime mortgage crisis in early 2007. In February 2007 Freddie Mac announced that it will no longer purchase risky subprime mortgages and other mortgage-related securities and in April 2007 the New Century Financial Corporation filed for Chapter 11 bankruptcy protection. The European Debt Crisis of August 2012 and the Chinese stock market turbulence of August 2015 mark further periods of acceleration of the spillovers across markets.

We observe that each market acts both as a transmitter and a receiver of spillovers during different sub-periods.[6] The pairwise spillovers presented in Figure 3 offer a more detailed picture on the dynamic relationship of each pair of markets.

[Figure 3, about here]

The graph for the Pair H-M gives the directional spillovers from the housing to the mortgage market.[7] In view of these findings, we further examine more closely the extent to which return spillovers across the four markets are shaped by behavioral and macroeconomic forces. In particular, we consider the following determinants of spillovers: investor sentiment (SENTIMENT) as constructed by M. Baker and Wurgler (2006), the availability of mortgage credit (TIGHTCREDIT),[8] the US economic policy uncertainty index (UNCERTAINTY) developed by S. R. Baker, Bloom, and Davis (2015), the role of the business cycle (RECESSION),[9] an indicator variable for the period of the mortgage crisis (MORTCRISIS), as well as the boom and bust cycles for each of the four markets (HBOOM, MBOOM, EBOOM and SBOOM). The regression results for the net spillovers are reported in Table 3 and the results for the pairwise spillovers are presented in Table 4.

[Table 3, about here]

[Table 4, about here]

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[6] For example, in the early 2000s the housing market was a net transmitter of spillovers while the mortgage market was a net receiver of spillovers. However, this relationship reversed with the onset of the financial crisis. During the 2007-2009 period the mortgage market transmits spillovers while the housing market receives spilloves. The four graphs reveal that from 2010 onward the housing and the mortgage REITs markets are mostly net receivers of spillovers while the stock market and the equity REITs market are mostly net transmitters of spillovers.

[7] The transition from positive to negative values around 2007 illustrates that mortgage markets turns from a receiver to a transmitter of spillovers around this time period. Overall, during the crisis the spillovers are running in the direction from the mortgage market to the other three markets. However, after the financial crisis volatility shocks in the stock market spilled over to equity and mortgage markets as well as to the housing market.

[8] For the causal effect between subprime mortgage lending and house prices see Anenberg, Hizmo, Kung, and Molloy (2015).

[9] The business cycle variable (RECESSION), available from FRED, is a monthly indicator variable taking on the value of one during recessions and zero otherwise. It captures the recessions in the first part of 1980, in the 1981-1983 period, in the second part of 1990, in the period after the dot-com bubble in 2001, and the Great Recession of 2008-2009.

We observe that the housing market transmits spillovers during recessions, housing market busts, periods of bearish investor sentiment, and periods of tight lending standards. However, it was a net receiver of spillovers during the subprime mortgage crisis.[10] The mortgage market, in contrast, was a net transmitter of spillovers during the crisis.[11] As expected, the stock market transmits spillovers in periods of economic booms, in periods of heightened political uncertainty and in periods of loose lending standards. Overall, in periods of optimistic investor sentiment and in housing market booms the more liquid equity markets transmit spillovers to the housing market, while during recession periods the housing market is a net transmitter of spillovers.

4. Conclusion

In this paper we report large variations in the total, net and pairwise return spillovers between the housing market, mortgage and equity real estate investment (REITs) markets, and the stock market in for more than 40 years of monthly data on returns in the U.S. These markets act as both receivers and transmitters of spillovers during specific subperiods. Results pointed to an unprecedented direction of spillover transmissions during the financial crisis: while typically the housing market transmits spillovers during economic and housing market downturns, during the financial crisis the housing market was a receiver of spillovers from the REITs market. In addition to carrying implications for households, institutional investors, and regulators, our findings could be useful for the theoretical modelling of the interdependence between these markets. Recent contributions to the theoretical literature have focused on understanding how the interaction between mortgage lending, securitization, and housing price dynamics shapes the tradeoff between home ownership affordability and financial

[10] While this finding might be associated with the fact that our financial crisis variable, by construction, captures only the early stages of the crisis, August 2007-September 2008 (housing prices continue to fall throughout 2009 and 2010), it could be interpreted as evidence that that spillovers during the global financial crisis were subject to mechanisms that are different from the ones operating in other recession periods. The recent literature has uncovered a number of differences in the dynamics of housing returns between the most recent financial crisis and previous recession periods. Damianov and Escobari (2016), for example emphasize that, unlike in previous housing market cycles, in the most recent cycle "starter" homes appreciated more during the boom and depreciated more during the bust of the market (see, e.g. Poterba (1991) and Mayer (1993) for an analysis of the 1970-1980 time period).

[11] As we will establish in the subsequent analysis of pairwise spillovers, risks from the mortgage market spilled over to the housing market during the financial crisis.

stability (see, e.g. Campbell (2013), Guren, Krishnamurthy, and McQuade (2017)). Our empirical results can inform these and future efforts by contributing to a better understanding of the forces shaping risk spillovers across these markets.

References

Anenberg, E., Hizmo, A., Kung, E., & Molloy, R. (2015). *The Effect of Mortgage Credit Availability on House Prices and Construction: Evidence from a Frontier Estimation Approach*.

Antonakakis, N., André, C., & Gupta, R. (2016). Dynamic Spillovers in the United States: Stock Market, Housing, Uncertainty, and the Macroeconomy. *Southern Economic Journal, 83*(2), 609-624.

Antonakakis, N., & Floros, C. (2016). Dynamic Interdependencies Among the Housing Market, Stock Market, Policy Uncertainty and the Macroeconomy in the United Kingdom. *International Review of Financial Analysis, 44*, 111-122.

Baker, M., & Wurgler, J. (2006). Investor Sentiment and the Cross-Section of Stock Returns. *Journal of Finance, 61*(4), 1645-1680.

Baker, S. R., Bloom, N., & Davis, S. J. (2015). *Measuring Economic Policy Uncertainty*. (NBER Working Paper No. 21633).

Campbell, J. Y. (2013). Mortgage Market Design. *Review of Finance, 17*(1), 1-33.

Chiang, M.-C., Sing, T. F., & Tsai, I.-C. (2017). Spillover Risks in REITs and other Asset Markets. *Journal of Real Estate Finance and Economics, 54*(4), 579-604.

Damianov, D. S., & Escobari, D. (2016). Long-run Equilibrium Shift and Short-run Dynamics of U.S. Home Price Tiers During the Housing Bubble. *Journal of Real Estate Finance and Economics, 53*(1), 1-28.

Davis, M. A., & Nieuwerburgh, V. (2015). Housing, Finance, and the Macroeconomy. *Handbook of Regional and Urban Economics, 5*(Chapter 12).

Diebold, F. X., & Yilmaz, K. (2012). Better to Give than to Receive: Predictive Directional Measurement of Volatility Spillovers. *International Journal of Forecasting, 28*(1), 57-66.

Gerardi, K., Rosenblatt, E., Willen, P. S., & Yao, V. (2015). Foreclosure Externalities: New Evidence. *Journal of Urban Economics, 87*, 42-56.

Guren, A. M., Krishnamurthy, A., & McQuade, T. J. (2017). *Mortgage Design in an Equilibrium Model of the Housing Market*. (Working Paper, Boston University).

MacKinnon, J. G. (1996). Numerical Distribution Functions for Unit Root and Cointegration Tests. *Journal of Applied Econometrics, 11*(6), 601-618.

Mayer, C. (1993). Taxas, Income Distribution, and the Real Estate Cycle: Why All Houses Do Not Appreciate at the Same Rate. *New England Economic Review*, 39-50.

Mayer, C., Pence, K., & Sherlund, S. M. (2009). The Rise in Mortgage Defaults. *Journal of Economic Perspectives, 23*(1), 27-50.

Poterba, J. (1991). House Price Dynamics: The Role of Tax Policy and Demography. *Brookings Papers on Economic Activity, 2*, 143-203.

Shahzad, S. J. H., Ferrer, R., Ballester, L., & Umar, Z. (2017). Risk transmission between Islamic and conventional stock markets: A return and volatility spillover analysis. *International Review of Financial Analysis, 52*, 9-26.

Zivot, E., & Andrews, D. W. K. (1992). Further evidence of the great crash, the oil-price shock and the unit-root hypothesis. *Journal of Business and Economic Statistics, 10*, 251-270.

Appendix: Tables and Graphs

Table 1: Summary statistics, unit root tests, and correlations

Panel A: Summary Statistics				
	H	M	E	S
Mean	0.004	0.006	0.010	0.009
Median	0.004	0.010	0.014	0.014
Maximum	0.020	0.159	0.270	0.121
Minimum	-0.023	-0.276	-0.381	-0.255
Std. Dev.	0.006	0.054	0.050	0.044
Skewness	-0.767	-1.207	-1.537	-0.930
Kurtosis	4.863	7.452	14.806	6.281
Jarque-Bera	122***	537***	3119***	298***
Observations	503	503	503	503
Panel B: Unit Root Tests				
ADF	-2.765*	-20.323***	-17.205***	-20.918***
PP	-3.787***	-20.323***	-20.251***	-20.918***
Zivot-Andrews	-8.444***	-8.976***	-9.589***	-10.058***
Panel C: Correlation Matrix				
H	1.000			
M	0.044	1.000		
E	0.131***	0.518***	1.000	
S	0.044	0.044	0.589***	1.000

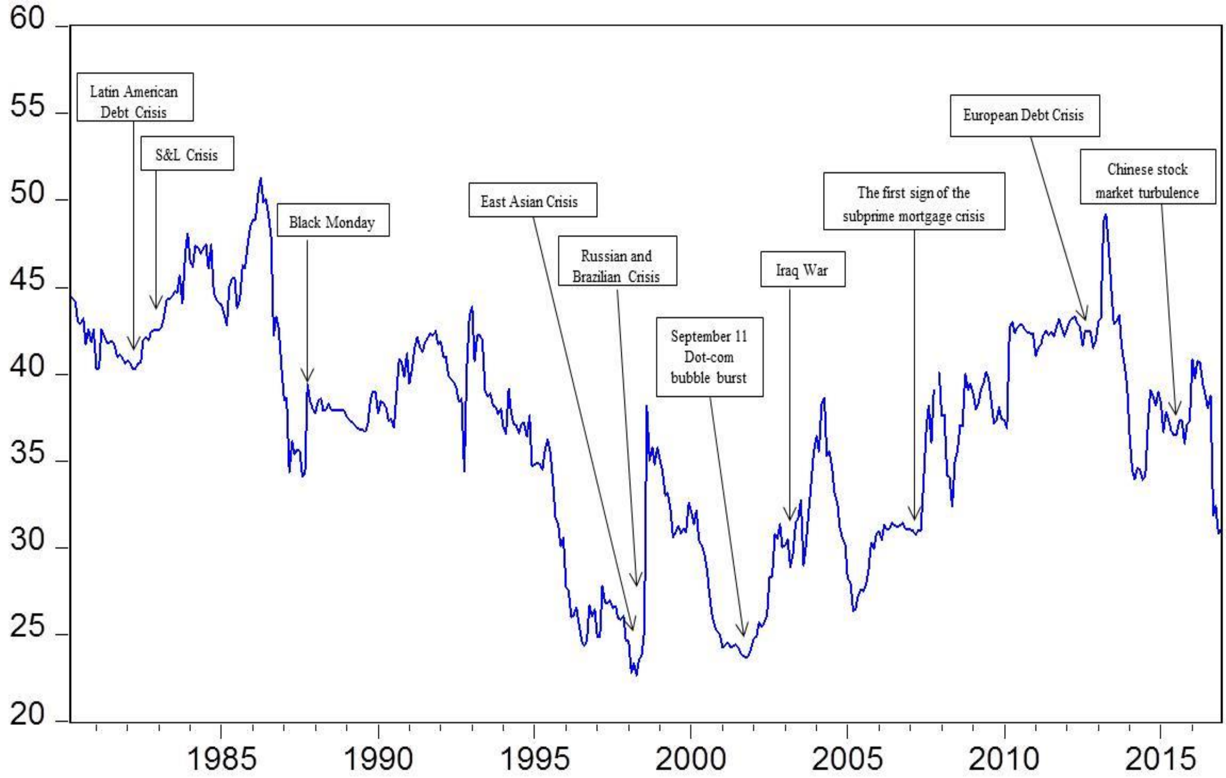
Notes: Reported statistics are of the returns on the main variables used in the VAR model over the full sample starting from January 1975 to December 2016: (H) stands for the S&P/Case-Shiller home price index, (M) stands for the mortgage REITs index, (E) stands for equity REITs index, and (S) stands for the S&P 500 index. Panel B reports results of Augmented Dickey-Fuller, Phillips-Perron and Zivot-Andrews unit root tests with a constant term where the lag length is determined by Schwartz Information Criteria (SIC). Critical values for the ADF and PP unit root tests are based on MacKinnon (1996) whereas critical values for the Zivot-Andrews test are taken from Zivot and Andrews (1992). The significance levels are indicated as follows: ‘***’ $p<0.01$, ‘**’ $p<0.05$, ‘*’ $p<0.1$.

Table 2: Total return spillovers

	From				
To	H	M	E	S	Contr. from others
H	87.01	3.46	5.29	4.24	13.0
M	0.35	67.31	18.60	13.73	32.7
E	1.74	16.37	59.25	22.65	40.8
S	0.88	13.27	22.94	62.91	37.1
Contr. to others	3.0	33.1	46.8	40.6	123.5
Contr. including own	90.0	100.4	106.1	103.5	Total Spillover Index=30.9%
Net Contr. (Spillovers)	-10.0	0.4	6.0	3.5	

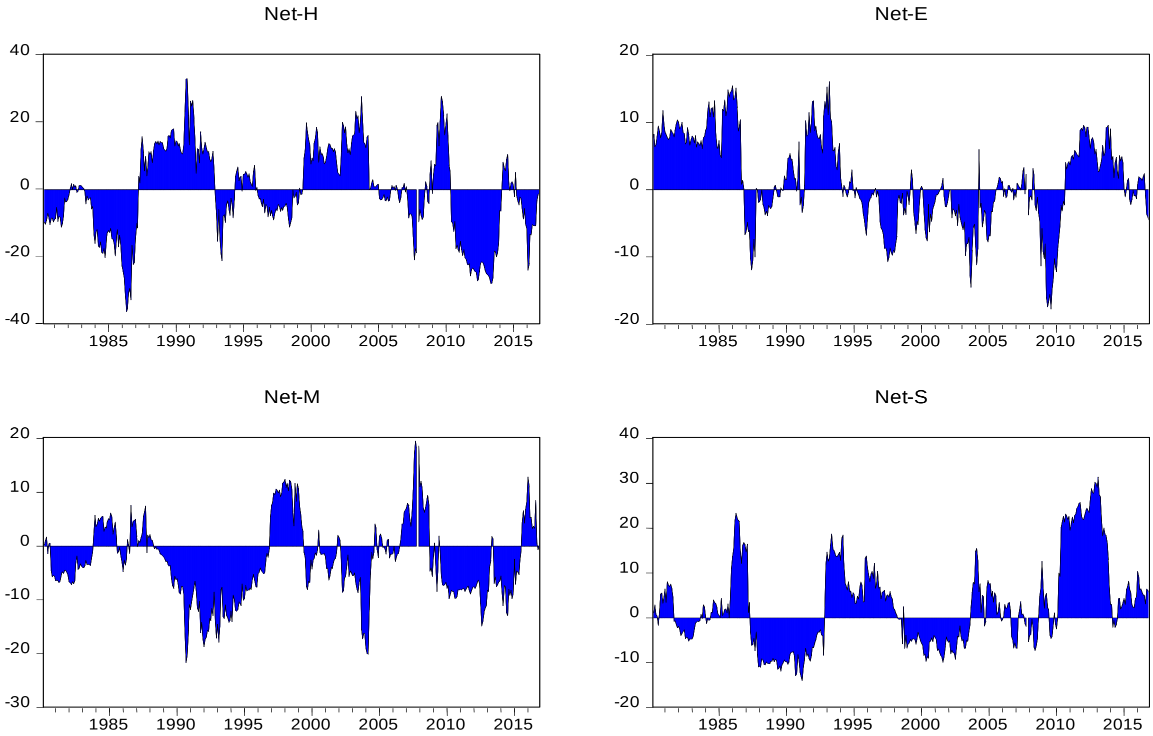
Notes: The underlying generalised variance decomposition matrix is based on a monthly VAR of order 2 with 10-step ahead forecasts. The number of lags (2) has been selected based on Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQ). The last column gives the aggregated off-diagonal row sums (directional from others) and the off-diagonal column sums represent contributions to others. The differences between contributions to/from others (net contributions) are shown in the last row of the table.

Figure 1: Total return spillovers across four markets



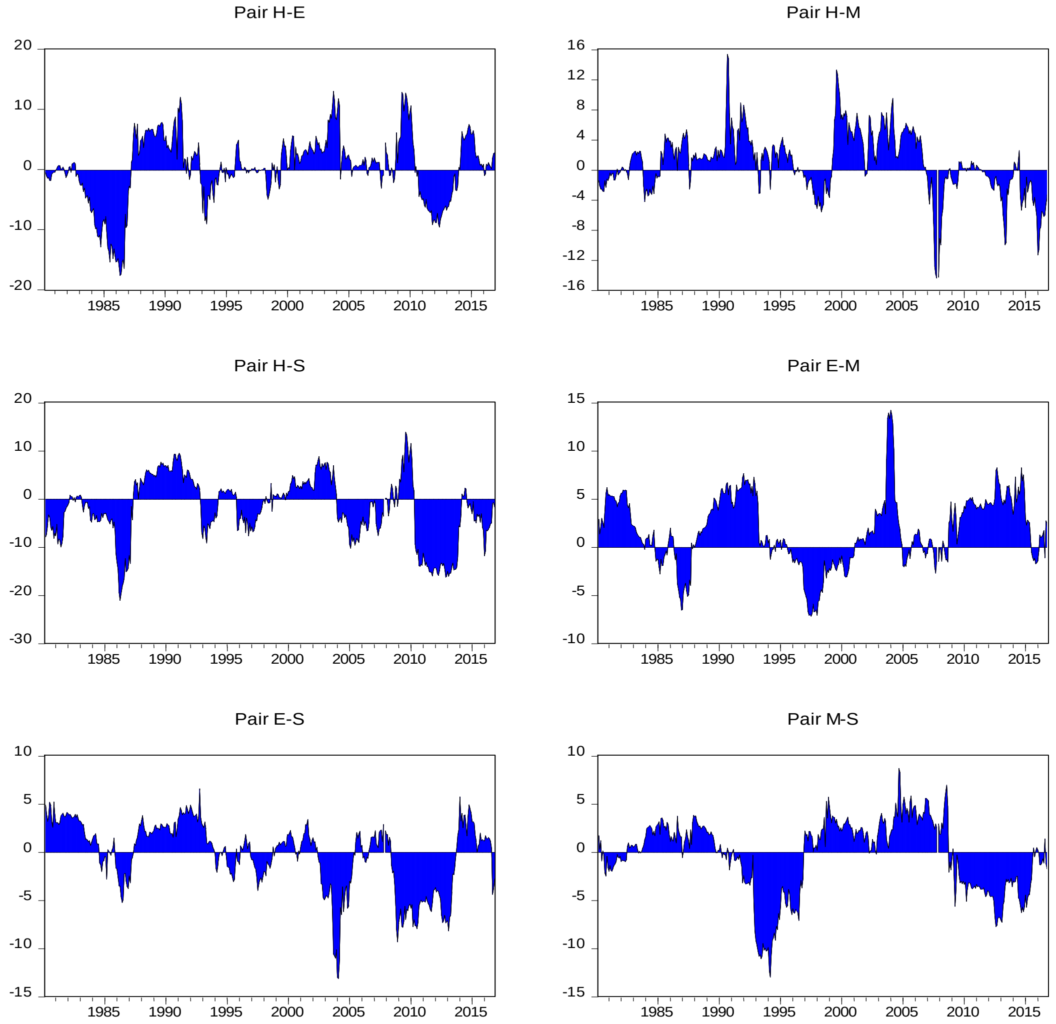
Notes: The total return spillover index across the four markets is based on generalized variance decomposition associated with a VAR of order 2 with a 10-step ahead forecast horizon and a 60-months rolling window.

Figure 2: Net return spillovers



Notes: The total return spillover index across the four markets is based on generalized variance decomposition associated with a VAR of order 2 with a 10-step ahead forecast horizon and 60-months rolling window. Positive values indicate that the market is a net transmitter and negative value that the market is a net receiver of spillovers.

Figure 3: Pairwise return spillovers



Notes: The total return spillover index across the four markets is based on generalized variance decomposition associated with a VAR of order 2 with a 10-step ahead forecast horizon and 60-months rolling window. The relationship Pair H-E shows the directional pairwise spillover effect running from the housing market (H) to the equity REITs market (E). The interpretation of the remaining pairwise comparisons is analogous.

Table 3: Regression results for net spillover

Dep. variables:	Net-H	Net-M	Net-E	Net-S
MORTCRISIS	-14.18***	14.26***	3.502**	-3.580
	(3.638)	(1.787)	(1.409)	(2.661)
RECESSION	11.98***	-4.955***	-0.0178	-7.011***
	(3.188)	(1.566)	(1.235)	(2.331)
UNCERTAINTY	-0.121***	-0.0606***	0.0282***	0.153***
	(0.0227)	(0.0111)	(0.00878)	(0.0166)
TIGHTCREDIT	0.158***	0.113***	-0.183***	-0.0879***
	(0.0457)	(0.0225)	(0.0177)	(0.0334)
SENTIMENT	-3.354***	2.862***	2.111***	-1.620*
	(1.149)	(0.565)	(0.445)	(0.840)
HBOOM	-5.334***	2.261***	1.842***	1.231
	(1.585)	(0.778)	(0.614)	(1.159)
MBOOM	-2.259	2.037**	-0.396	0.618
	(1.698)	(0.834)	(0.658)	(1.242)
EBOOM	-2.248	1.852**	0.869	-0.473
	(1.634)	(0.803)	(0.633)	(1.195)
SBOOM	2.742	-1.036	-0.121	-1.585
	(1.680)	(0.825)	(0.651)	(1.229)
Constant	14.01***	0.574	-4.691***	-9.894***
	(2.623)	(1.288)	(1.016)	(1.918)
Observations	236	236	236	236
R-squared	0.323	0.499	0.451	0.431

Notes: The table reports the results for the net spillovers regressions defined by equation (10). Hereby Net-H denotes the net spillovers transmitted by housing market, Net-M the net spillovers transmitted by the mortgage REITs market, Net-E stands for the net spillovers of the equity REITs market, and Net-S stands for the net spillovers of the stock market as measured by the S&P 500 index. The regressions are based on monthly observations from January 1996 to August 2015. All regressions are estimated by OLS with Newey-West serial correlation consistent standard errors. The standard errors are reported in parentheses. The significance level of the regressions is indicated as follows: '***' $p<0.01$, '**' $p<0.05$, '*' $p<0.1$.

Table 4: Regression results for pairwise spillovers

Dep. Variables:	Pair H-M	Pair H-E	Pair H-S	Pair E-M	Pair E-S	Pair M-S
MORTCRISIS	-8.128***	-4.305***	-1.749	-2.765***	1.961**	3.368***
	(1.223)	(1.318)	(1.953)	(0.957)	(0.868)	(1.033)
RECESSION	3.405***	4.627***	3.951**	3.537***	1.073	1.988**
	(1.071)	(1.155)	(1.711)	(0.839)	(0.761)	(0.905)
UNCERTAINTY	-0.0166**	-0.0522***	-0.0521***	0.0295***	-0.0535***	-0.0477***
	(0.00761)	(0.00821)	(0.0122)	(0.00596)	(0.00541)	(0.00643)
TIGHTCREDIT	-0.0192	0.0398**	0.138***	-0.0985***	-0.0449***	-0.00494
	(0.0154)	(0.0166)	(0.0245)	(0.0120)	(0.0109)	(0.0130)
SENTIMENT	0.108	-2.319***	-1.142*	-2.395***	2.186***	0.575*
	(0.386)	(0.416)	(0.617)	(0.302)	(0.274)	(0.326)
HBOOM	-2.893***	-0.626	-1.815**	-0.508	1.724***	-1.140**
	(0.533)	(0.574)	(0.851)	(0.417)	(0.378)	(0.450)
MBOOM	-0.279	-1.201*	-0.779	-1.187***	-0.411	0.571
	(0.571)	(0.615)	(0.911)	(0.447)	(0.405)	(0.482)
EBOOM	-0.917*	-0.940	-0.391	-0.661	0.590	0.274
	(0.549)	(0.592)	(0.877)	(0.430)	(0.390)	(0.464)
SBOOM	0.829	1.098*	0.815	0.264	0.714*	0.0565
	(0.565)	(0.609)	(0.902)	(0.442)	(0.401)	(0.477)
Constant	4.019***	7.470***	2.521*	0.316	2.464***	4.909***
	(0.881)	(0.950)	(1.408)	(0.690)	(0.626)	(0.745)
Observations	236	236	236	236	236	236
R-squared	0.345	0.296	0.302	0.502	0.525	0.350

Notes: The table reports the results for the pairwise spillover regressions defined by equation (11). All regressions are estimated by OLS with Newey-West serial correlation consistent standard errors. Pair H-M denotes the net pairwise spillovers between the housing and the mortgage REITs markets. It is defined as the return spillovers that the housing market transmits to the mortgage market minus the spillovers that the housing market receives from the mortgage market. The regressions are based on monthly observations from January 1996 to August 2015. The standard errors are reported in parentheses. The significance level is indicated as follows: '***' p<0.01, '**' p<0.05, '*' p<0.1.